Report on the three-year postdoctoral fellowship of Lucy Semaan:

The HFF-UOB Post-Doctoral Fellowship (PDF) that was granted to Lucy Semaan for a period of three years, from November 2015 to October 2018, is the first initiative of its kind by HFF in Lebanon. The research is undertaken under the joint supervision of Dr. Nadine Panayot-Haroun, head of the Department of Archaeology and Museology (DAM) at the University of Balamand (UOB), Lebanon, and Dr. Lucy Blue, Director of the Centre for Maritime Archaeology (CMA) at the University of Southampton (UOS), UK. The main research interest of this PDF considers the development, significance, and affordances of the seascape of the ancient site of Anfeh, in North Lebanon; and looks into how people used and modified this seascape through time. This PDF also contributes to capacity building in the field of maritime archaeology in Lebanon, one of the Honor Frost Foundation main goals.

This report presents the main activities undertaken during the course of the fellowship in terms of fieldwork campaigns, fieldschools, and training offered to students, as well as other academic tasks such as report writing and publications.

1. The site of Anfeh

Anfeh, is a village in the Koura district of the North Governorate of Lebanon. It is located 15 km south of Tripoli and 70 km north of Beirut. The coastal village is extended by a nose-shaped promontory, 400m long with a maximum width of 120m and oriented on an east-west axis and separated from the hinterland by three moats to the east. The latter promontory is called Ras al-Qalaat and is roughly oriented on a NNW-SSE axis while rising some 14 metres AMSL. Anfeh is delimited by the village of Chekka and the Barghoun River to the south, the agricultural area of Hraishi to the north followed by the village of Qalamoun, and the villages of Barghoun and Zakroun towards the east (Figure 1).

The coastline north of Ras al-Qalaat is exposed as it offers no lee from the dominant SW winds. It consists of cliffs that drop in places onto a narrow rocky shore that is hazardous for seafaring. Closer to the peninsula, the coastline forms two large well-protected shallow bays – the Nhayreh Bay and the bay of Ras al-Safi – that offer natural havens . Due to coastal urbanisation that started developing in the 1980s, both sides of the Nhayreh Bay are occupied by modern beach resorts. This leaves a narrow space in the bottom of the bay for the present-day modest fishermen's harbour. To the south of Ras al-Qalaat, the rocky shoreline is low-lying and consists of a small cove with an open bay that are suitable for anchoring and landing places when the northerly winds blow, being in the lee of the promontory. Anfeh's coastline is also characterized by raised erosion platforms and wave-notches, as well as a series of submerged reefs running parallel to Ras el-Qalaat on a NNW-SSW direction, and submerged terraces with marmites in shallow near-shore waters.

Geologically, Sanlaville (1977: 786- 792) named two phases after the area of the Riss-Würm period (150 000-75 000 BP) at the site of Anfeh: Enféen I and Enféen II. Enféen I corresponds to the rapid rise in sea-level to 20 metres AMSL, followed by a marine transgression which led to another rise in sealevel up to 13 metres AMSL during the Enféen II. Anfe's promontory is formed of Tortonian limestone which dips towars the NNW at 20° to 25° (Sanlaville 1977: 356). Sanlaville (1977: 357-358) recognized five geological layers on the promontory: The lowest and first layer is made of biodetrital sandstone. This layer is topped by reddish biodetrital sandstone with clay and pebbles. On top of this, there is a layer of a biodetrital yellowish fine and porous sandstone, which is 3 metres thick. Finally, there is a thin layer of

reddish clayey sandstone covered by a two-metre layer of biodetrital sandstone, on which the houses are built. In the geological map of Lebanon, Dubertret (1955) portrays the area to the north of the promontory as made of Miocene marly conglomerates and limestone reefs and in the south is made of quaternary arable lands. Subsequent to the submarine earthquake and tsunami that hit the Lebanese coast in 551 CE, a shoreline-fringing vermetid bench suddenly emerged by approximately 80 cm, as indicated by thirteen 14C-calibrated ages between Anfeh and Beirut (Elias et al. 2007). This rocky shoreline is prone to erosion from winds and marine action that cause its regression.

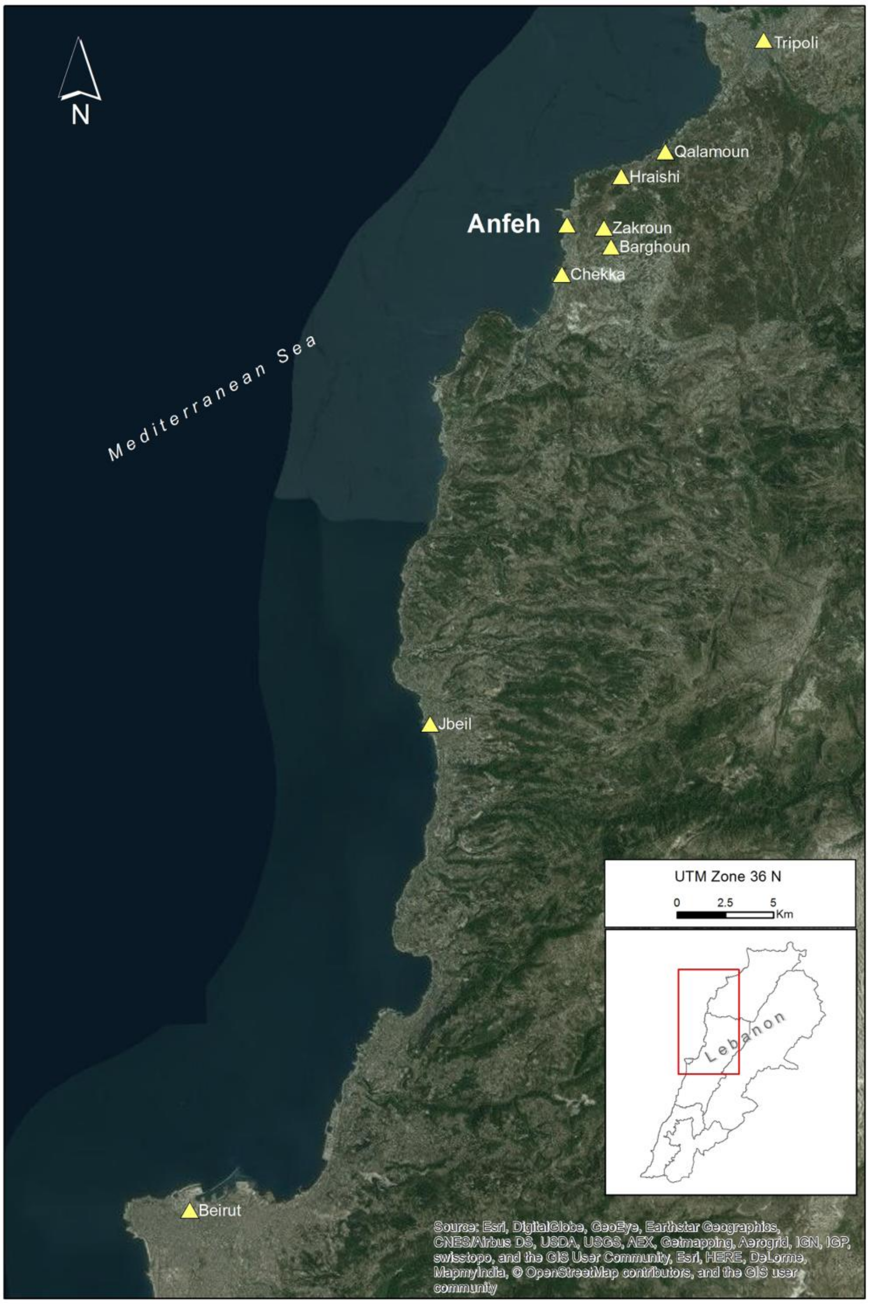


Figure 1: Location of Anfeh and neighbouring areas (C.Safadi).

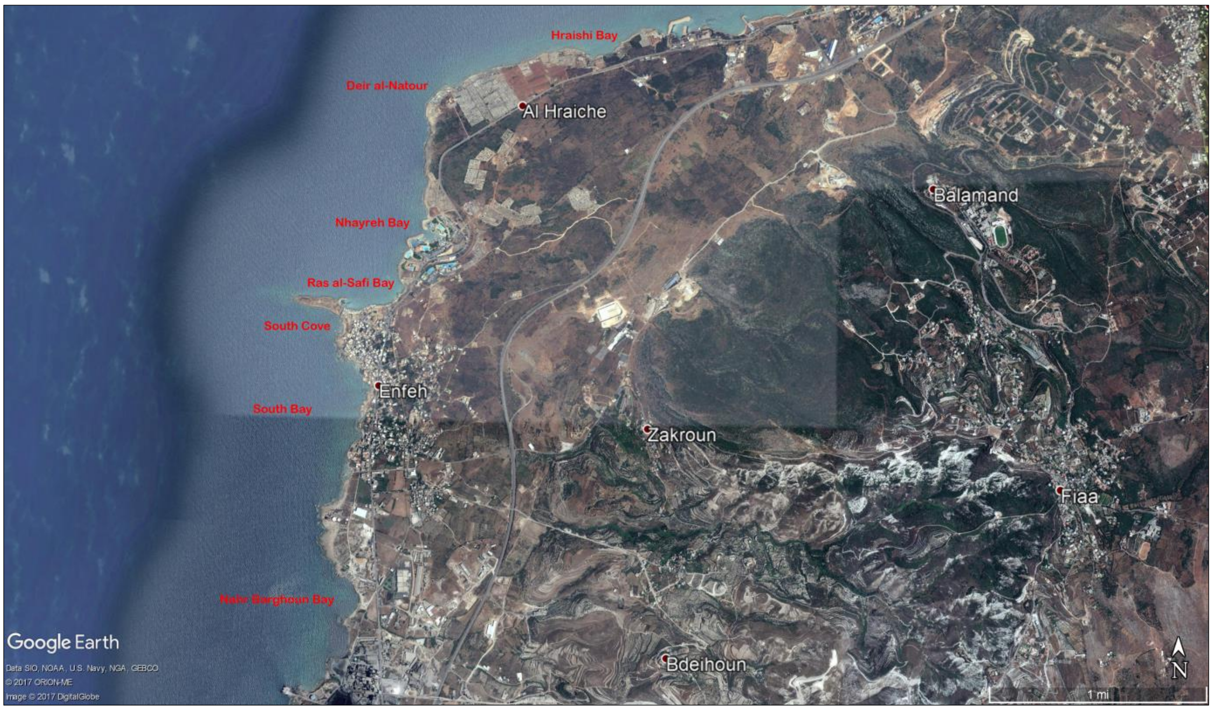


Figure 2: Google Earth aerial image showing the bays mentioned in the text, across the survey area (Modified from Google Earth 2017).

The site of Anfeh is being studied since 2010 by DAM under the direction of Dr. Nadine Haroun- Panayot and testifies to an occupation of the promontory of Ras al-Qalaat and the modern town of Anfeh that extends most likely from the Early Bronze Age to the Ottoman period (Panayot-Haroun 2015, 2016, 2016b).

At the kind invitation of Panayot-Haroun, I led a team of maritime archaeologists in October 2013 to undertake an underwater visual survey of the waters adjacent to the Anfeh peninsula (Semaan 2016; Semaan et al. 2016). The three weeks survey was funded by the Honor Frost Foundation and supported logistically by generous sponsors. It was able to assess the underwater archaeological potential at Anfeh and obtain a preliminary idea of the physical settings and underwater topography. More importantly it warranted future research at the site and gave way to the establishment of my post-doctoral research that considers the development of Anfeh's seascape through time.

The marine survey area mirrors the extension of the coastal survey area while extending some 600 meters to the west of the tip of Ras al-Qalaat. The survey area was divided into 375 squares during the 2013 campaign and was enlarged to 702 squares by the end of the project (Figure 2). The georeferenced squares of the grid are 100 × 100 metres, numbered and oriented on a north-south axis. 132 squares were covered in the course of the

underwater archaeological research at Anfeh: 67 squares had been covered in the 2013 underwater survey field season, with 44 squares covered during the Hraishi underwater survey in July 2017 (See 2.5), and 21 squares covered on the southern coastline of Anfeh in the September-october 2017 survey (See Section 2.6).

From 2013 to 2018, 616 dives were undertaken at the site, which equates to 610 hours and 54 minutes spent underwater.

2. Fieldwork Campaigns

During the course of the postdoctoral fellowship, I have undertaken 9 fieldwork seasons at the site of Anfeh in order to deepen my understanding of its seascape. These fiedlwork campaigns extended between periods of two weeks to a month, with a number of team members ranging from as little as two to ten people. These members varied in age, professions, skills, experience and nationality. Along with Lebanese team members, archaeologists from twelve different countries Colombia, Denmark, Egypt, France, Germany, Greece, Italy, the Netherlands, Serbia, South Africa, Switzerland, and the UK, all brought their collective effort to making every season a success.

What follows is a list of the fieldwork campaigns undertaken at Anfeh which aims and objectives, methodologies, challenges, and preliminary results are detailed below.

2.1. Underwater photogrammetry season, May 2016.

2.2. Conservation of a privately-owned collection of pottery artefacts recovered from the sea at Anfeh, June-September 2016.

2.3. Sea-level changes and maritime landscape study with Dr. Nicholas Carayon, September 2016.

2.4. Remote-sensing by the University of Patras, June 2017.

2.5. Underwater visual survey at Hraishi Bay, July 2017.

2.6. Underwater visual survey coupled with photogrammetry recording, September-October 2017.

2.7. Geomorphological study by Dr. Clement Flaux, April 2018.

2.8. Underwater excavations, June-July 2018.

2.9. Underwater excavations, September 2018.

2.10. Petrographic analysis of anchors

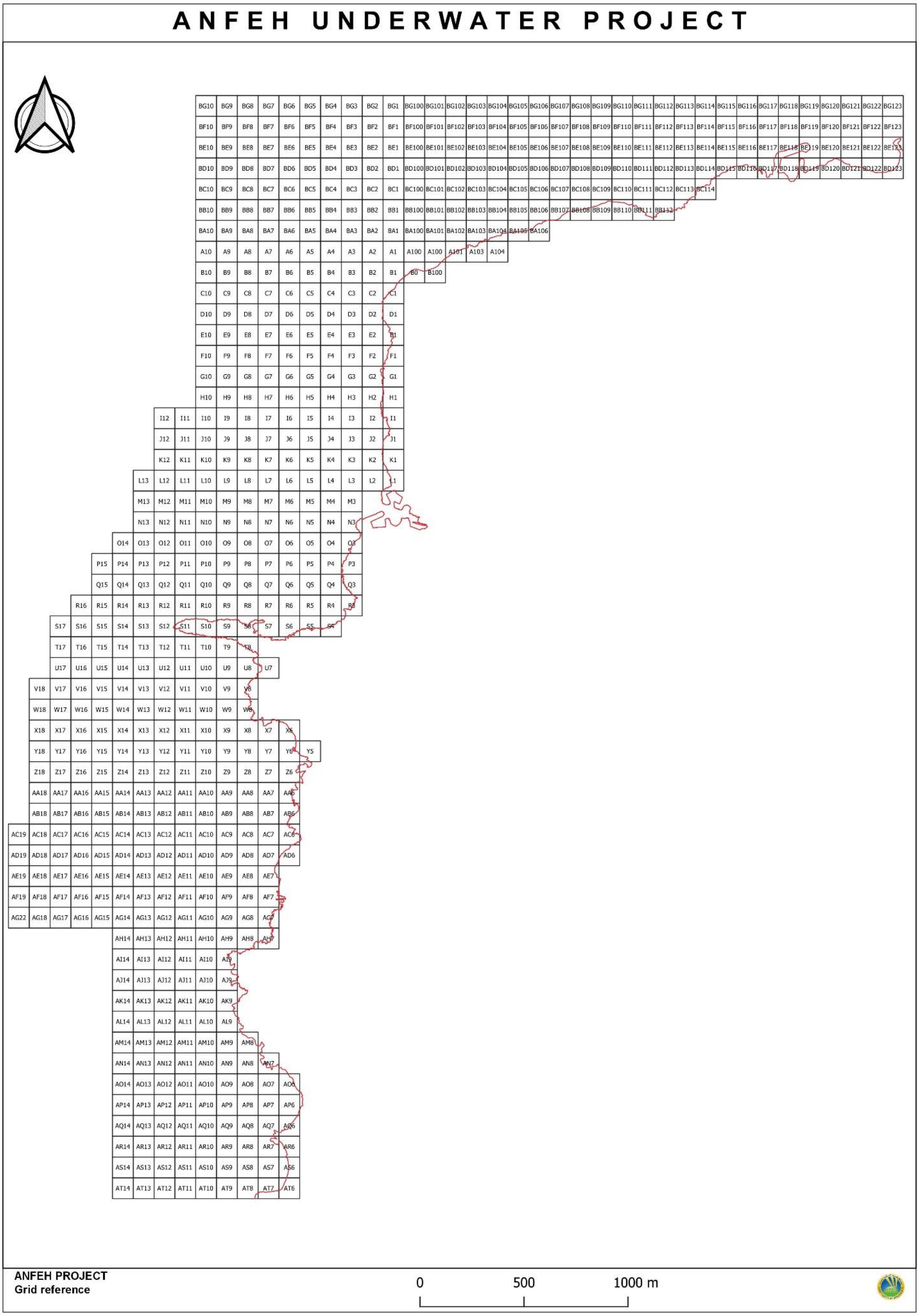


Figure 3: Map of the georeferenced grid system which covers the underwater survey area (E. Cocca).

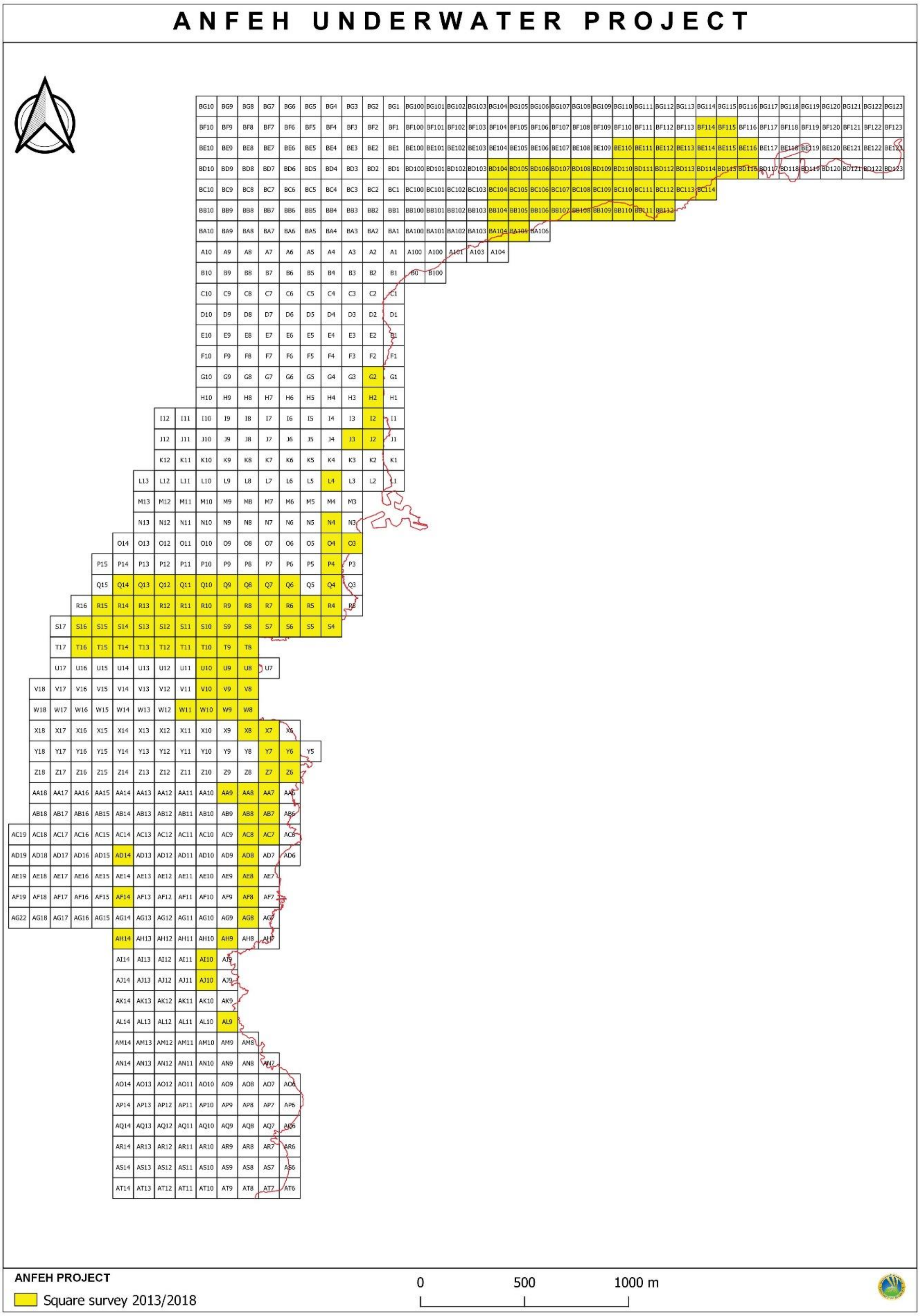


Figure 4: Map of the surveyed squares between 2013 and 2018 (E. Cocca).

2.1. Underwater photogrammetry season, May 2016.

The 2013 visual survey undertaken in the waters of Anfeh had shed light on the nature and extent of the underwater cultural heritage at the site. Hence, the one-month fieldwork season in May built on the results of the 2013 underwater visual survey and entailed underwater 3D photogrammetry to map a substantial number of anchors located on the bottom of the southern reef of Ras al-Qalaat; three large group of masonry blocs with one located on the south-eastern side of Ras al-Qalaat and two others on north-western and north-eastern sides of the promontory; as well as isolated masonry blocs located sporadically in front of Anfeh's southern coastline. Photogrammetry was also undertaken on land to map three slipways/ramps at the site (Figure 5); as well as to produce 3D models of anchors retrieved during the 2013 campaign. From the 3D models, we were able to also generate orthophotos, 3D-PDFs, and DEM models (Semaan 2016a; Semaan & Salama forthcoming).

This proved to be a successful outcome and continuation of the previously funded research by HFF. It also served in rapidly documenting Anfeh's UCH and protecting it from potential looting. This fieldwork was also the opportunity for regional mobility exchange of people, ideas, and expertise between DAM and the Centre for Maritime Archaeology and Underwater Cultural Heritage (CMAUCH) at the University of Alexandria.

The team used four different underwater photography systems for data collection:

- GoPro HERO4 Black Edition with its stock underwater housing.
- Canon PowerShot G15 compact camera, with an underwater Fantasea housing
- Canon EOS 70D DSRL equipped with a Canon 20mm lens that provides with an IKELITE Underwater TTL housing, mounted on an aluminium tray with dual quick release handles, and with a modular 8inch dome with 2.75inch lens extension. The whole kit was completed with two DS-161 strobes and their light diffusers.

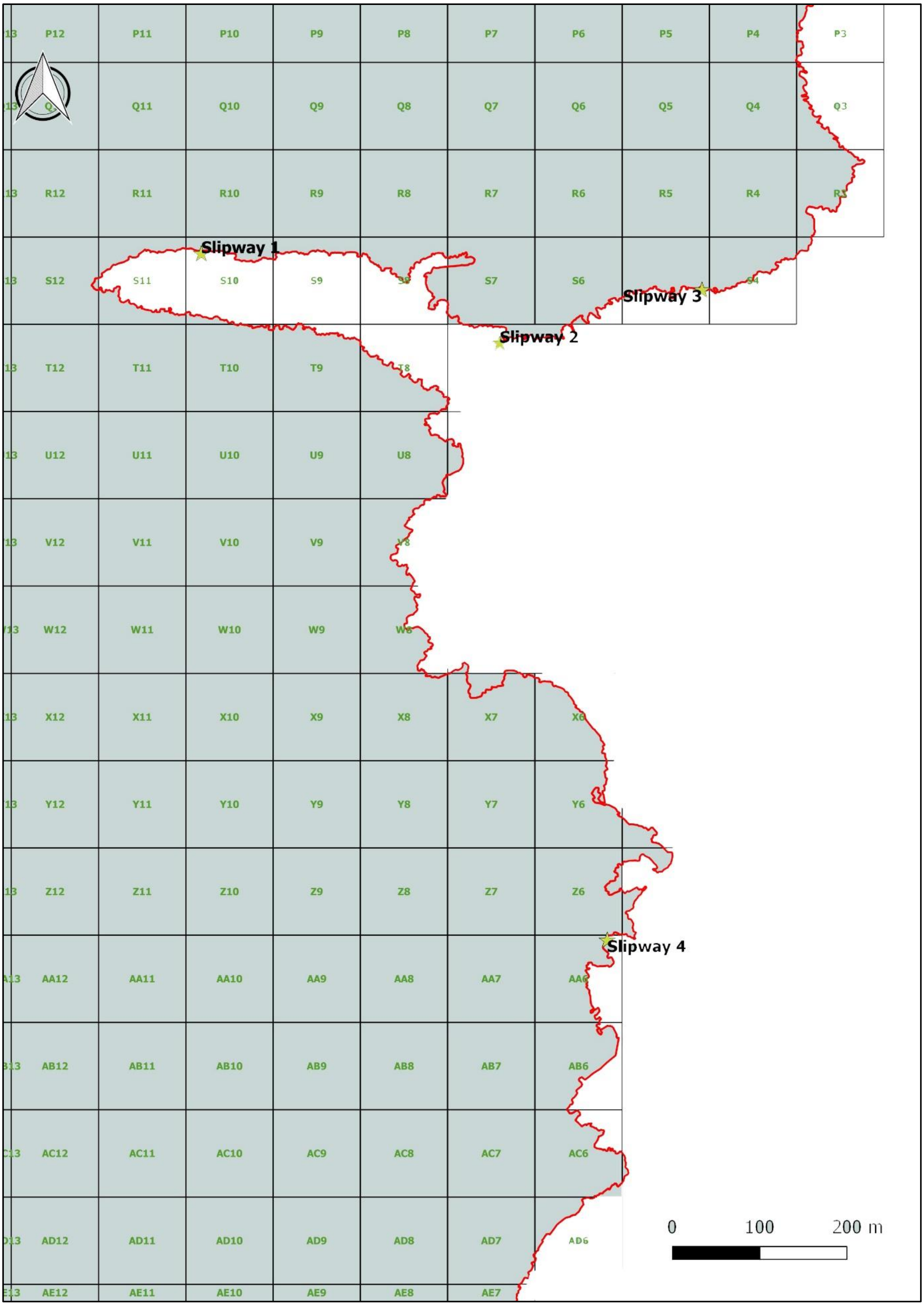


Figure 5: The location of the ramps/slipways documented through photogrammetry. Slipway 4 was documented at a later stage in 2017.

Processing was done with the Agisoft Photoscan software and a MSI GT80 Titan SLI laptop with a 2.70-GHz Intel Core i7-6820HQ CPU, 32 GB of RAM and Dual NVidia GeForce GTX video card. Meanwhile, images were taken with an overlap of more than 50% between them at an estimated angle of 45°-70°, and from different positions while swimming in a circular and/or a zigzag pattern. Underwater the targeted areas were cleaned from debris and algae ahead of image capturing, with scales bars placed next to the objects. Data was processed on site as soon as it was obtained by the end of each day. Some models required more processing time than others and these were completed subsequently at the CMAUCH.

In conclusion, this fieldwork was the first endeavour of its kind in Lebanon where the research team has demonstrated the impact of 3D photogrammetry on archaeological practice in a marine environment in a low-funding context, where more expensive geophysical equipment such as AUVs and ROVs was not possible. The team was mainly able, through the implementation of a time and cost-effective methodology, to capture tridimensional measurements of submerged artefacts as well as studying these in their natural environment while minimising disturbance. Measurements obtained from three-dimensional photogrammetry helps in mitigating human errors taken through traditional real-time measurements while operating in a challenging environment where currents, visibility and depth impairs human judgment and perception of accuracy.

The archaeological results from of this photogrammetry campaign are still being analysed and interpreted. A few preliminary remarks, however, can be made here: The substantial amount of anchors of various sizes, lying at the foot of the southern reef of Ras al-Qalaat, suggests that this reef might have been a popular anchorage location in antiquity in the lee of the northerly winds. The presence of rock-cut ways of access and stairways on the peninsula's southern face might also indicate that goods were transferred to the shore from anchored boats. The three-dimensional models of anchors have allowed detailed measurement as well as more accurate volumetric and weight estimation. This helps in establishing their typology; as well as supporting a better understanding of their spatial distribution, and positioning. The estimation of the weights can also inform estimates of ship sizes and types.

Results concerning the mapped masonry blocks are also still under study. Still, first-hand observations indicate that the blocks located in adjacent areas of Ras al-Qalaat, might have been once part of the medieval fortress that stood on the promontory (See Chaaya 2016). Their presence underwater can be explained through two factors: (1) the collapse of built stone architecture on the promontory due to tectonics and weather conditions; or (2) the dismantling and transfer from the promontory to meet the construction needs of the modern village of Anfeh, and/or further afar to the city of Tripoli which is located some 15km north of Anfeh.

Finally, the use of underwater photogrammetry at Anfeh creates a great potential for a positive contribution to public outreach for underwater archaeology in Lebanon. Indeed, one of the future objectives of the research project at Anfeh is to provide an underwater trail that will allow divers to visit the anchorage. This will help to generate social significance for underwater archaeology, disseminate knowledge, and raise awareness of the importance of the underwater cultural heritage.

2.2. Conservation of a privately-owned collection of pottery artefacts recovered from the sea at Anfeh, June-September 2016.

From June to September 2016, I trained four archaeology students from the Lebanese University-Tripoli Branch in 1st-aid conservation of pottery from a marine environment (Figure 6). The students were given related theory along with copies of relevant literature. They were also able to document, clean, conserve, and partially restore more than 60 pottery artefacts from start to finish. This collection was kindly lent to DAM by a local fisherman who was keen on safeguarding it. The students and the fisherman were also made aware of the UNESCO 2001 Convention and its importance in protecting and documenting the UCH in non-intrusive manners.



Figure 6: Training UL students on preliminary conservation of uw materials, Anfeh, Lebanon.

2.3. Sea-level changes and maritime landscape study with Dr. Nicholas Carayon, September 2016.

In collaboration with Nicolas Carayon, I undertook a systematic coastal survey in September 2016 in order to identify maritime ways of access to and from the sea, as well as sea-level indicators and better understand how these reflect on the coastal archaeological rock-cut features such as slipways, landing-stages, moats, and basins.

We covered the littoral strip on foot, starting at the small cove adjacent to the southeast limit of Ras al-Qalaat, across the southern maritime quarry and the large southern bay until the pebble bay of the river Barghoun. This constituted an orthodromic distance of slightly more than 2 km. The walking survey to the north of the promontory encompassed the bays of Ras al-Safi and Nhayreh, the promontory of Ras al-Natour, until the bay of Hraishi (Figure 4). Documentation was made first-hand through onsite observations with note taking and photographs, as well as through taking measurements with a level theodolite. This coastal walk-by survey was accompanied by snorkelling all along the northern and southern facades

of Ras al-Qalaat to locate and record any submerged wave-cut notches and platforms that would indicate past sea levels.

We were able to identify several harbouring possibilities along the coastal landscape: two offshore anchorages, four bays protected by the promontory, four coves, five locations adequate for beaching, and two river mouths also good for beaching, as well as rock-cut ramps or slipways that give access to and from the sea. As for sea-level change we were only able to establish a relative chronological relation through identifying four locations with clear indicators. These included onland current erosion platforms; uplifted terraces; and traces of quarrying activity; and an underwater notch that runs all along the northern side of the Ras al-Qalaat. It also seems that the uplift happened only on the southern coast of Anfeh. We were not able to getting a definite datation and our findings needed to be corroborated by a specialist geomorphologist (See below Section 2.7)

2.4. Remote-sensing by the University of Patras, June 2017.

In June 2017, the Department of Archaeology and Museology at UOB in collaboration with the University of Patras, Greece (UOP) undertook a remote-sensing survey at the site of Anfeh. The team was composed of six people from the Marine Laboratory of Marine Geology and Physical Oceanography at the Geology Department of the UOP[1].

This geophysical survey complemented the 2013-2016 underwater visual surveys at Anfeh as it systematically covered large areas of the seabed. It is time and cost effective since it allows a rapid investigation of the seafloor, which would otherwise be time-consuming through conventional scuba-diving survey methods. Hence, the employment of this technology restricts diving hours to the ground-truthing phase. Another advantage of the remote-sensing technology is that it provides the archaeologist with a broader view of the seafloor than that of the visual field of a diver. The main objectives of this survey are twofold: the first pertains to establishing the underwater topography and characterisation of the seabed, as well as the paleogeography of the area and changes in sea level. The second aim is to identify and assess the underwater cultural heritage at the site through detecting surface and subsurface targets of potential archaeological interest.

16 - The team from UOP was composed Prof. George Papatheodorou, Dr. Maria Geraga, Dr. Dimitris Christodoulou, Dr. Elias Fakiris, Xenophon Dimas, and Nikos Georgiou; and the team from the DAM- UoB was composed of Dr. Lucy Semaan and Mario Kozaily.

Four different systems were set on the boat. These were a bathyswath interferometric multibeam system; dual frequency side-scan sonar with a 272TD towfish and a digital recording unit Edgetech 4100P; a digital single-beam hydrographic echosounder Elac Nautic Hydrostat 4300; and a high-resolution Kongsberg GeoPulse Plus Chirp sub-bottom profiler; and a Hemisphere V100 GPS system. Visual inspection of some of the identified targets was accomplished during ground-truthing that was carried out using a SEAVIEWER underwater tow camera.

The area covered equated 10km^2, with track lines equating 139 lines and a total length of 196,870 metres. Out of these 139 lines, 20 lines were parallel to the shore while the rest were perpendicular to it. The depths reached vary between 0 to 60 metres, and in some places down to 70 metres. Going beyond these depths was not possible as the westernmost reef, running on a northeast-southwest direction, drops dramatically since an underwater cliff started at 60 metres. This might indicate that such offshore areas could benefit from a deep-sea survey using ROVs or AUVs in the future to locate evidence for shipwrecks. The general trackline plan that was executed was based on lines with 50 metres spacing; however, in some areas — such as north of the tip of the promontory — the spacing was reduced to 20 metres for a denser coverage. Indeed, in the 1970s and 1980s Amadouny had identified the northern tip of the promontory at 21 metres of depth as an area of archaeological interest (Amadouny 1999: 63-64; Semaan 2016: 57).

A few preliminary conclusions can be made at this stage:

- More than a hundred targets were identified during this remote-sensing survey, some of these however might have been doubly identified.
- A number of the seven targets that were ground-truthed via the Seaviewer underwater camera were artificial man-made reef of tires perhaps thrown by fishermen to encourage marine life.
- No archaeological evidence was identified in real-time on the seabed. This demonstrates the extensive illegal looting of the UCH, as is commonly reported through hear-say to the archaeologists by the locals in Anfeh. It also indicates that elements of UCH might be currently buried under the sediments, and/or they are to

be located elsewhere at deeper depths, that is, beyond the reach of recreational diving.

- A detailed reconstruction of the paleogeomorphology of the site and the changes in sea-level was reached.

2.5. Underwater visual survey at Hraishi Bay, July 2017.

Subsequent to documenting and surveying the waters adjacent to Ras al-Qalaat and the village’s coastlines, I decided to move the investigation to the northern edge of the survey limit in order to investigate potential maritime links with the site of Anfeh and its promontory. In addition, the interest to thoroughly investigate this area was also encouraged by pioneering underwater archaeologist and diver Zareh Amadouny, who I had personally met. Amadouny was among the very few professional divers who explored the areas of Deir al-Natour and al-Qalamoun area from 1970-1973. He published the results of his surveys in a book (Amadouny 1999: 40-48) and in a short report (Amadouny 1980). Amadouny also surveyed the bay of Hraishi and the salt marshes next to Deir al-Natour where he retrieved two handles and four amphora necks with their handles and rims, all dating from the end of the first century AD.

In July 2017, I led a small team of divers to undertake an underwater visual survey in the Hraishi area with special attention to the offshore area of the Hraishi Bay, in order to assess its underwater cultural heritage (Semaan 2017). This area is located northeast of Deir al-Natour and west of al-Qalamoun, some 2.70km northeast of Ras al-Qalaat (Figure 7, Figure 8).

The underwater topography is mainly characterised by a shallow rocky sea-bottom lying at 1.8meters bsl, which is very eroded and dotted with oval pits. It becomes more flat with a few pockets of sand towards the north at depths of 4 to 5 metres and gives way to higher reef formations with larger sand pockets as it slopes down northwards to 10 meters bsl. Between the depths of 11 to 12 meters, the underwater reef formations drop quite roughly onto a flat sea floor covered with pebbles and sand at the depths of 14 to 20 metres bsl. Despite being heavily looted during and after the Lebanese Civil War (1975-1990), and most probably largely destroyed by dynamite fishing at the time, pottery remains, anchors and metal nails and ingots were identified in gullies and pockets of sand.

The archaeological material mapped and documented is still under study and no overarching conclusions can be made at this point. However, initial observations indicate that the offshore area of the Hraishi Bay — mainly the sea bottom lying at a depth of 10 to 12 metres — could have been used as a temporary anchorage spot in calm weather for boats plying the maritime route between Anfeh and Tripoli. The anchorage might have been temporary since the bay is quite open to both winds directions from the north and southwest. In addition, the shoreline is difficult of access as the coast is formed of limestone active cliffs. Some of the underwater material could have also been the results of wreckage material of boats that were caught in storms. The presence of material at the shallow depths of 2-4 metres testify to the dominant westerly currents which could have dragged submerged material further east towards the coast. The rocky bottom at these shallow depths is not deep enough for cargo ships to moor and the coastline does not offer any loading places for lighters to be beached. It does allow however small-sized craft to moor close to the shore, while larger boats would anchor further out at sea in calm weather.



Figure 7: The location of Hraishi Bay and the survey area between Deir al Natour to the south-west and al-Qalamoun to the north-east.

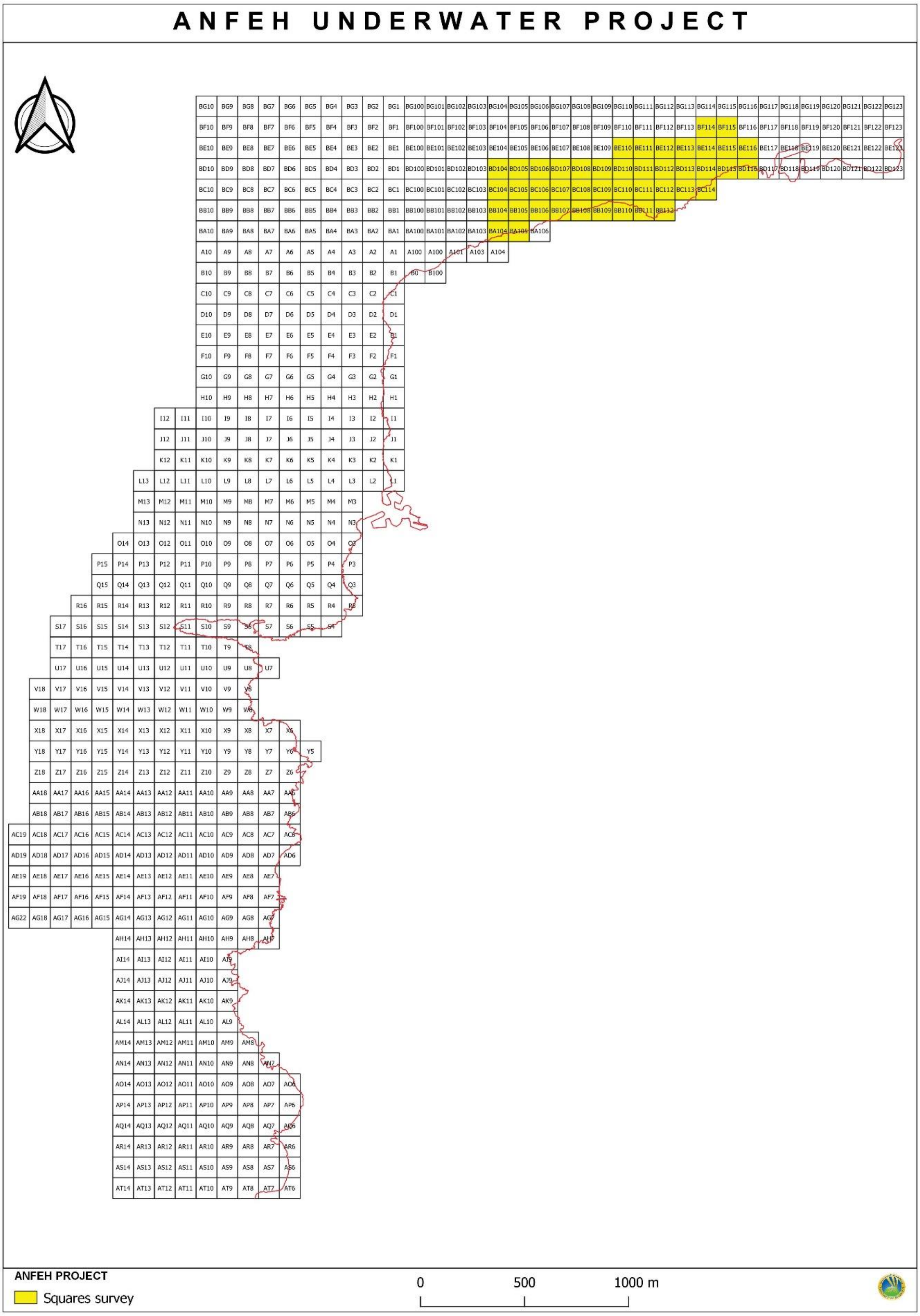


Figure 8: the 44 squares covered by the underwater visual survey undertaken at Hraishi (E. Cocca).

2.6. Underwater visual survey coupled with photogrammetry recording, September-October 2017.

Several maritime accesses were identified on the southern coast of Anfeh, to the south of the promontory of Ras al-Qalaat, subsequent to the costal survey I undertook with Nicholas Carayon in September 2016 (See Section 2.3; Semaan & Carayon 2016). A foreseeable outcome of this study was to verify the presence of underwater archaeological material in the sea facing these accesses, and by extent, attempt to ascertain their nature and functionality, and whether any prolongation in the sea can be identified. Concurrently, the team also completed the photogrammetry recording tasks that were left pending during the 2016 May season (See Section 2.1). These included:

- The underwater photogrammetry of the masonry blocs located to the north of the peninsula in square R10, and to the south in squares T8 and T9 (Figure 4).
- The geo-referencing through the use of total station of the four slipways, and the masonry blocs located in R10 and T8, and T9 (Figure 4).
- The completion of the photogrammetry recording of Slipway 1, located at the northwestern side of Ras al-Qalaat (Figure 5).
- The photogrammetry of Slipway 4, identified in September 2016 (Figure 5).

The targeted area extended on the southern coastal strip of Ras al-Qalaat in Anfeh and covered 21 new squares (Figure 9). A new geo-database was specifically built for the project by Dr. Enzo Cocca from the University of Napoli “L’Orientale”. This geodatabase was created in PostgreSql/Postgis and the forms were written in python code. This has facilitated the management and connection of the alphanumeric data, media data and vector data.

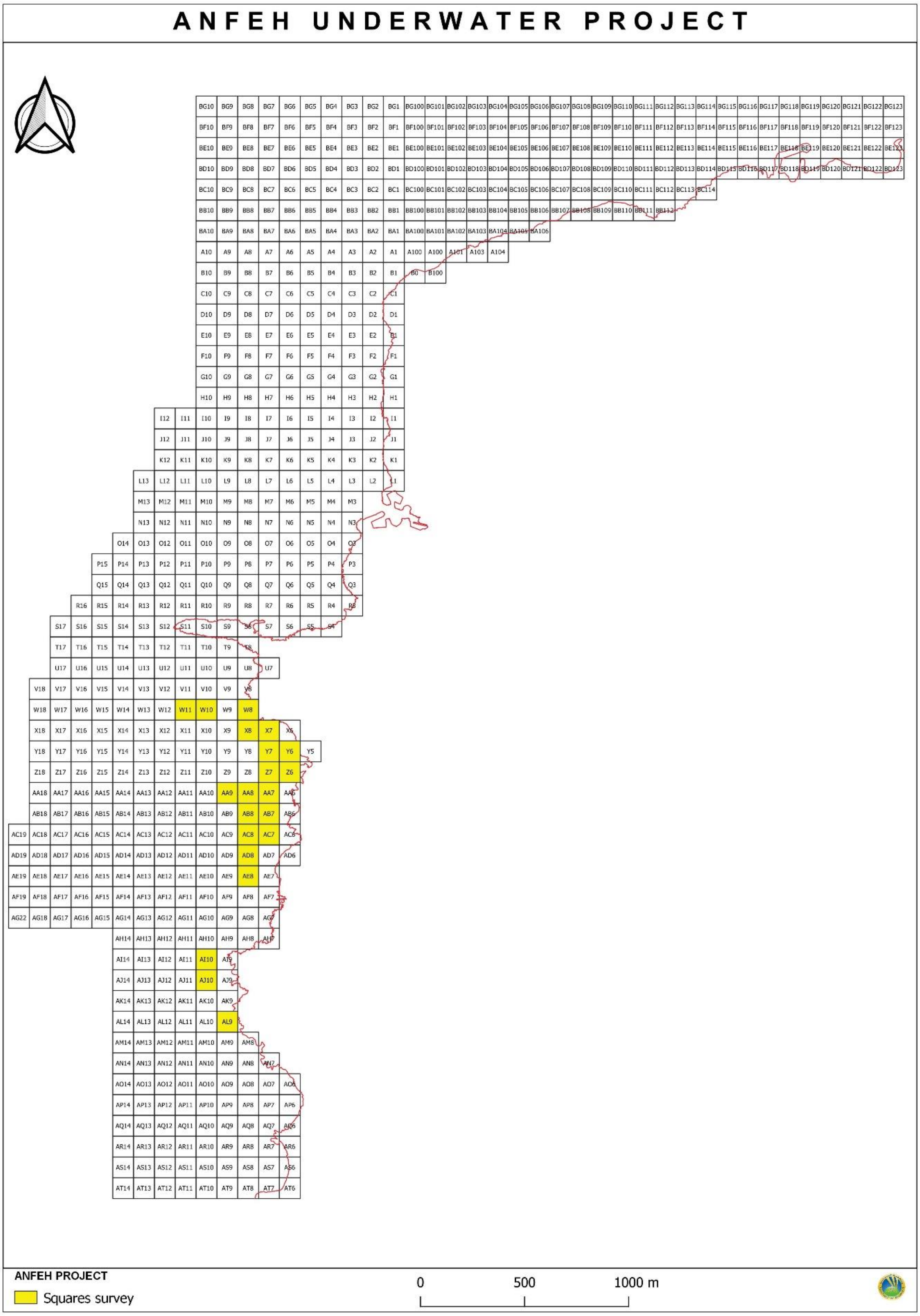


Figure 9: Map showing the squares covered during this campaign (E. Cocca).

Surveying the southern maritime approaches of Anfeh's coastline revealed a heavily disturbed area. Not only the urbanization of the coast has surely modified the onland topography but it has also impacted the underwater environment. There was a lot of modern debris filling the crevasses and sand pockets mixed with modern trash. The visibility was quite low at times due to the presence of debris and the some unidentified suspension matter in the water. The southernmost areas are mostly influenced by the cement factory and its dumping of mountain-extracted sediments in the sea. Consequently, the bay of Nahr Barghoun is heavily polluted, especially with possible waste from nearby illegal settlement camps. Diving was hence unadavised in the this bay.

Throughout the southern area of Anfeh, the shallow reefs and terraces extend some 15m from the seashore lay at 1.5m to 2.5 metres in most of the places. Approaching this area with boats even small ones would be a hazard due to the shallow reefs and their protuberances. This leads to consider that boats would have needed points of access through such topographical barriers. More weight was then given to the potential hypothesis that these maritime accesses (located with Carayon in 2016) were used in antiquity. The absence, of archaeological evidence might seem to negate this. Indeed, only one broken anchor was identified as almost no archaeological material was located. Such absence can be due also to the modern disturbance of the seabed. Carayon suggested that it might be due to the fact that since it is a launching area for boats to and from the land, these would not necessarily leave material behind, like they would do when lying at anchor.

2.7. Geomorphological study by Dr. Clement Flaux, April 2018.

Dr. Clement Flaux undertook a geomorphological survey from the 10 to 21 April 2018 along Anfeh's coastline. This survey built on the previous study by Lucy Semaan and Nicholas Carayon (Semaan & Carayon 2016), which looked at sea-level changes and maritime ways of access in the area. It also aimed at refining the results on the reconstruction of palaeoshorelines undertaken by the Marine Laboratory of Marine Geology and Physical Oceanography. Flaux's survey mainly focused upon past sea-level indicators and the record of erratic boulders quite abundant along Anfeh coast. Main coastal morphogenesis processes identified through the survey allowed to provide a preliminary discussion about the taphonomy of coastal archaeological remains. What follows is a summary of Flaux's fieldwork report on the geomorphological survey he undertook at Anfeh (Flaux 2018).

Anfeh rocky shorelines, as in most part of the Lebanon rocky coast, is characterized by the presence of an abrasion platform, karstified in the form of various coastal karren features (e.g. rock pools, blowholes, …) and elevated at an altitude of a few centimetres above mean high water level. Seaward the platform is rimmed by bio-constructions, build by the association of the vermetid gastropod *Dendropoma petraeum* and the coralline alga *Neogoniolithon notarisiia* (Févret et Sanlaville, 1965). Landward, the rocky platform ends by a small cliff, whose base is sometimes eroded in the form of a tidal notch. The sedimentary coast of Anfeh is characterized by beaches, lying within interrupted sections of the lithified quaternary coastal sands. Beaches are dominant along southern Anfeh, while the northern coast is mostly rocky. Beaches are mostly composed of calcareous pebbles, gravels and coarse sands, and abundant building materials and human wastes from cobbles to sands in size. High slope profile, coarse materials whose bigger part often lay in the upper beach suggest that beach morphology is mainly driven by storm event. During normal conditions of weather, pocket beaches may serve as mooring sites as previously noted by Carayon and Semaan (2016).

Well-preserved uplifted marine terraces found east of Anfeh-Chekka bay evidence the long-term, ongoing tectonic uplift. The last one to date is the result of the of the AD 551 earthquake (Elias et al. 2007).

All features were located during fieldwork using *NextGIS*, a geographic information system (GIS) program using the GPS system and WGS 84 pseudo-mercator coordinate system (EPSG 3857). Data were then transformed into WGS 84 mercator coordinate system (EPSG 4326) and transferred to *Quantum GIS* in order to store, organize and analyse them in comparison with geological and geomorphological maps of the region (Dubertret, 1955; Sanlaville, 1977), as well as the geoarchaeological survey led by Semaan and Carayon (2016). Altitude of ancient and modern coastal features were measured using an optical level and referred to the current and local biological mean sea-level (Laborel & Laborel-Deguen 1994).

The sea-level indicators recorded are platforms, notches, and fossil bioherms: 30 platforms were surveyed and measured along Anfeh's coast. They range from an elevation for 4 meters above msl to 20cm above msl. Notches corresponding to small recesses along rocky cliffs run along west-east sections of the coast and are usually 0.5 to 1 meters high with some preserved up to 1-2 meters. Some of the active notches intersect elevated ones which indicate two

different mean sea levels. In situ fossil vermetid bioherms were found at four locations with three located on the northern façade of Ras al-Qalaat and one to the southeast corner of the back of Slipway 4 on the southern coast of the town of Anfeh. They are situated at 25cm, 33cm, 70 cm, and 90 cm above msl. Considering these three sea-level indicators Flaux suggests four uplifts that date to the Holocene at: 1.2m, 2m, 3m and 4.2m above local biological msl that have a recurrent span of 1500 years since 6000 BC.

Flaux also recorded 43 sites where he surveyed erratic boulders found isolated or in clusters lying above modern or ancient coastal platforms. All boulders were found south of the Anfeh promontory, with the exception of one site of boulder located on the northern section of the first moat on the eastern side of Ras al-Qalaat. Boulders were mostly found backward NW-SE sections of the coastline that is exposed to the southwest. Where abundant boulders were found, their distribution is apparently dominantly organized along a SW-NE direction. Boulders range from ca. 0.1 to 6.5 m^3 in volume and many of them have a slab morphology, 0.3 to 0.6 m in thickness. Boulders can be found trapped within fractures and pools of the modern abrasion platform, flanked along coastal cliffs or erratic above uplifted platform. Numerous megaboulders present encrustations of marine fossils, represented by vermetids, serpules and balanes indicating that these boulders were removed from the initial position at the shoreline. The motion of these boulders and their organisation in a SW-NE direction is due, according to Flaux, to either storm events with dominant southwestern winds and swell from the open sea or the collapse of the northern façade of Ras al-Shaqaa in Chekka (south of Anfeh) that caused a local tsunami wave orientated towards Anfeh in the north. However, vermetids fixed upon the rocky slab recorded at one of boulder sites recorded (site 37) were dead in modern times according to radiocarbon analyse provided by Morhange et al. (2006). As neither a rockslide nor a tsunami has been reported in recent times, Flaux's data favours storm activity in the erratic boulders morphogenesis.

Flaux also looked at how uplifting processes and storm impacts, raises questions of taphonomy of the coastal archaeological findings. In relation to slipways (Figure 5), Flaux suggests that they were most probably operational before the 6th century uplift due to the active abrasion platform connected to their lower escarpment. As to the underwater material that was found underwater, he says, quite rightly, that these are not necessarily in situ as they might very well have been reworked and redistributed since their original time of deposition on the seabed. This is due to the dominant southwestern winds and swells and events of storm

and/or tsunami events. It would be interesting to further pursue this taphonomic line of research.

2.8. Underwater excavations, June-July 2018.

In the period of 12th June 2018 to 16th July 2018, underwater excavations were conducted north of the promontory of Ras al-Qalaat at Anfeh, by the Department of Archaeology and Museology of the University of Balamand. The main incentive behind undertaking these excavations were to ground-truth subsurface anomalies that were identified and mapped through a prior geophysical survey in the research area. The first anomaly that was targeted during the underwater excavations in June-July 2018 was Target 22, located some 74m north of Ras al-Qalaat at 14.5 meters of depth and 0.30-0.80 meters under the seabed, and was located in Square R10 (Figure 4). However, the location of Target 22 was covered by gillnets anchored to the seafloor. This made excavations impossible at this location and the team moved to Target 31 some 140 meters eastwards from Target 22.[2] The isometric profile of Target 31 had revealed anomalies located at depth of 13.2 meters underwater and 1.16 to 1.83 meters under the seabed which corresponds to 14.36 to 15.03 MBSL.

The excavations were led from a boat and were diver-based. They were conducted using a water dredge powered by a HONDA GX 160 water pump. The dredge was connected to the water pump through a 13 meter-long fire hose. The dredge head made of a fire hose jet nozzle fixed inside a 5inch-wide PVC tube. The latter was connected to a Y-shaped PVC part that was fitted to a 5m-long exhaust pipe on one end and a 2m-long flexible hose on the other. The flexible tube was held by divers and used for the suction of sediments.

The excavation strategy was adapted according to the nature of the layers and archaeological material. A trench of 5 meters on the North-South axis by 10 meters on the East-West axis was set at the location of Target 31. The strategy of open excavations was adopted rather than a grid system. Excavations extended and developed organically as surrounding topsoil needed to be gradually removed in order to avoid its collapse inside the trench, and as archaeological material was concentrated in certain locations of the trench rather than others. Archaeological layers were excavated in a controlled manner with the water dredge held by hand at a safe distance from sediments and artefacts. Hand fanning

[2] Target 22 was subsequently excavated in September 2018 upon the removal of the gillnets (See Section 2.9).

was equally used in order to carefully unearth finds for their documentation, surveying and removal. Recording was done through offsets measurements, trilateration, and photogrammetry. Indeed, photogrammetry was used for both recording and mapping of the finds and to track the progress of the layer excavations in the set trench through the DEM and orthophotos (Figure 10). It was also used for debriefing on the excavation day and for planning and briefing on new operations, strategies and actions.



Figure 10: Data collection by Darko Kovacevic above the trench.

The technical details of the dives, as well as the data collected and description of the dives, were logged in the written dive log books dedicated to this purpose. These were cross-referenced with the photo log, the artefact log, and the operation log. The diving and excavation data was stored in the QGIS database of the Anfeh underwater project that was created in 2017 by Dr. Enzo Cocca (See Section 2.6). Adobe Bridge was used for organising the photographic records and Agisoft Photoscan for the photogrammetry.

The diving team was formed of 10 divers with eight of them present for the full duration of the excavations and two of them periodically. The number of diving days added up to 19. By the end of the diving operations, a total of 165 individual dives were logged, adding up to

170.6 hours of underwater work. Depths of the dives varied between 12.7 metres until a maximum of 15 meters BSL.

In terms of excavations, the maximum depth of the area excavated within the trench was 1.80 to 2.0 meters below the sediments. The stratigraphy can be described as having three distinct layers of sediments. A total of 46 archaeological objects were recorded. These were organic materials such as remains of wood and bone, as well as inorganic material such as ceramic and stone. The majority of the artefacts were located in Layer 2 at a depth ranging between 14.0 to 14.1 meters. Basic desalination buckets were used for the artefacts retrieved from the sea. The artefacts are still in water at the time of writing of this report. Friable sherds will be treated with Primal33 diluted at 5%.

In conclusion, the fieldwork has methodological merit insofar as it is the first endeavour of its kind in Lebanon, that is, to complete remote-sensing surveying with underwater ground-truthing. The trench excavated in R9 at the location of Target 31 revealed one layer of archaeological finds (Layer 2) most probably corresponds to the anomalies located at the same depth range by the Sub-Bottom Profiler. Since the SBP has an accuracy of 30 cm, it might have picked up signals from the masonry blocs or the larger pottery body sherds. Understanding the nature of the site at this point in time is quite challenging. The archaeological material surveyed needs to be studied to help understand the site better in terms of periods attested and activity taking place. The distribution of the archaeological material seems to indicate either that this location was an anchorage spot in the lee of Ras al-Qalaat from the south-westerly dominant winds; or that the material discovered has drifted from elsewhere. The presence of worked or semi-worked stones is quite puzzling, as the pottery sherds lying next to them indicate that the latter might have been trapped next to the stones. These stones might have been used as ballast, or they were part of a shipment of construction material, since masonry blocs from structures that once stood on Ras al-Qalaat were dismantled and carried further afar.

2.9. Underwater excavations, September 2018.

In keeping with the ground-truthing of subsurface anomalies, the September excavations initially aimed at ground-truthing Target 22 located in Square R10, some 74m north of Ras al-Qalaat at 14.5 meters of depth and 0.30-0.80 meters under the seabed (Figure 4). The

gillnets, which were covering Target 22 were removed at the end of July. This made it possible for the team to excavate this area. The same diving, underwater excavations, documenting, and recording methodology and equipment were applied as the ones during the June-July 2018 campaign (Figure 11).



Figure 11: Maritime archaeologist Jack Pink priming the water dredge ahead of the excavations.

A trench of 5 meters on the North-South axis by 15 meters on the East-West axis was set at the location of Target 22. The four corners of the trench were located at different depths as the seabed slopes towards the north and the west. The NE corner was at 13.9 meters; the SE corner at 13.5 meters; the SW corner at 14.6 meters and the NW corner at 15.1 meters. This trench was excavated for a period of 9 days. Its surface at seabed level is made of fine yellowish sand and constitutes the overburden atop a consistent layer that remained unchanged throughout the excavations. The trench did not reveal any archaeological material, but a number of rectangular modern blocs; most of which had approximately the same dimensions: 50cmx28cmx19cm. These clearly belonged to gillnets that were once set at this location, and left underwater. Their distribution corresponded to the location of the anomalies recorded by the SBP. Thus, considering the depths and location of these blocs, the nature of the anomalies is not archaeological but modern. Excavating the trench further

was halted and its final state recorded through photogrammetry. The trench was not covered by geotextile as no archaeological material was uncovered.

Subsequently, it was decided to return to Trench T31 in Square R9 that was excavated earlier in June-July to continue its investigation (Semaan et al. 2018). A new trench (5mx5m) was set at the north-eastern side of the previous trench since most of the archaeological, and especially organic material, was found there. The geotextile and concrete blocks that were set at this location were removed and the backfill cleared in order to better link the two trenches together. The progress of the excavations of the northern eastern extension of Trench T31 was tracked via underwater photogrammetry for the remaining period of the fieldwork. The main area of excavations was in between the two trenches and progressed stratigraphically while lowering the two adjacent sections simultaneously. A total of 41 archaeological objects were recorded and mapped in Layer 2, ranging between the depths of 13.6 to 14.1 meters BSL. These were organic materials such as remains of wood, charcoal, seeds, and bone, as well as inorganic material such as ceramic and stone. At the end of the fieldwork season, depths reached were 14.6 metres of depth. Both trenches were covered with geotextile and concrete hollow blocks with a few sand bags.

In terms of diving, the team was formed of four to eight divers depending on the days. The number of diving days added up to 16. By the end of the diving operations, a total of 115 individual dives were logged, adding up to 115 hours and 45 minutes of underwater work. Depths of the dives varied between 11.3 metres until a maximum of 16.2 meters BSL.

In conclusion, the presence of drift wood, charcoal, as well as overcooked pottery sherds seems to indicate the remains of a boat that was sank due to a fire on-board. The bones all belong to animals that served as food such as cow, sheep, and fish. Also included in the diet were olives/olive oil attested by the presence of olive pits as well as grapes/wine indicated by the grape seeds. The pottery analysis is ongoing, while the C14 analyses of organic material is highly warranted. Two core samples were undertaken underwater from Layer 2 where there was a high concentration of charcoal included in the layer. Their content is being analysed by geologist Clement Flaux.

2.10. Petrographic analysis of anchors

In September 2018, Dr. Ziad el Murr[3] undertook the sampling of seven anchors retrieved from the sea at Anfeh and of ancient quarry sites in the village in order to determine the anchors' provenance (Figure 12). Such analysis provides insights into the local or foreign exploitation of quarries for anchors. In the case of a foreign origin, this supports evidence for navigation routes and networking between different agencies in the region and further afar.



Figure 12: Dr. Ziad el Murr sampling one the anchors with a saw.

The sample analysis is currently undertaken at the facilities of the Lebanese Atomic Energy Commission - National Council for Scientific Research and comprises:[4]

- Standard thin section petrography was used to reveal the fabric and texture of the samples. For the time being only the six stone anchor samples were subjected to this procedure due to lack of time.

- Elemental analysis using Particle Induced X-ray Emission (PIXE) was applied on all samples to determine their chemical composition. The results will be used to compare the elemental

[3] The scientific personel also involves Manale Noun, Mohammad Roumié, Ali Srour, from the following LAEC-CNRS labs: Archaeological Sciences Laboratory (ASL), IBA laboratory, Vibration Spectroscopy Laboratory, ToF-SIMS laboratory.

[4] The following is taken from the progress report by Dr. Ziad el Murr.

signature of the quarries and the anchors. This will help revealing whether or not the artefacts are of local stone source.

- Scanning electron microscopy observation and Energy dispersive spectrometry (SEM-EDS) microanalysis and X-ray mapping were applied on the six anchor samples. These are useful to study the texture of the limestone matrix and distribution of elements, especially Mg, inside the sample as well as other discriminating element that help differentiate each sample.

- Raman spectroscopy and Time of Flight - Secondary Ion Mass Spectrometry (ToF-SIMS) were used to identify minerals in the six anchors samples.

So far, all samples have been prepared and PIXE, Raman, ToF-SIMS analysis have been completed. Petrography has been applied on five thin section samples and SEM-EDS on two mounted samples. All results will be provided during the period of December 2018. However, these will need further discussion, interpretation and research in collaboration with geologists before a definitive conclusion can be reached.

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3. The 2017 NAS Fieldschool

The Department of Archaeology and Museology and the Nautical Archaeology Society (NAS) organised the first fieldschool in underwater archaeology in Lebanon, which ran from the 7th to the 10th of September 2017. The fieldschool was generously supported by the Honor Frost Foundation as part of its initiatives to build local capacity in the country. DAM also hosted the tutors and the participants, and put the site of Anfeh at their disposal for their practical training in recording and surveying. A total of ten people participated in the NAS Recorder Skills course and the Surveyor Skills, mainly students of archaeology as well as archaeologists and diving amateurs of archaeology who came from all regions of Lebanon and attended lectures along with dry and wet practicals (Figure 13).

My role as a facilitator, dive leader, and impromptu lecturer included the following tasks:

- Assisting in the preparations and organization for the fieldschool.
- Taking minutes for the duration of the courses.
- Assisting with translation from English to Arabic when necessary.
- Presenting the site and the previous archaeological surveys done in the area.
- Giving a presentation about the UNESCO 2001 Convention and the legal framework of underwater archaeology in Lebanon.
- Leading the dive for one of the teams of participants.
- Co-writing the final report with Dorothy Chakra.



Figure 13: Introducing the underwater archaeology at the site of Anfeh to NAS participants.

4. TRAINING

I attended Introductory Courses on Conservation and Restoration of Archaeological Finds from Underwater Environments, The International Centre for Under-water Archaeology

(ICUA), Zadar, Croatia (16–27 November 2015). Subsequent to this training I could correctly ensure the preliminary conservation of the artefacts that were retrieved from the sea.

5. RESEARCH STAY AT THE UNIVERSITY OF SOUTHAMPTON

As part of the development of research, access to resources, and supervision meetings with Dr. Lucy Blue, I was regularly going to the UK for research stays at the Centre of Maritime Archaeology at University of Southampton. I had three stays in total: for the month of February 2016; from the 18 to the 30 October 2016; and from the 22 January to the 9th February 2018.

6. List of report written on the fieldwork campaigns

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